DOCUMENT RESUME

ED 105 869 IR 001 901

AUTHOR Burdman, Robert
TITLE Intermittent Feedback Schedules in Videotaped Programmed Instruction.
PUB DATE Apr 75
NOTE 47p.; Paper presented at the Annual Conference of the Association for Educational Communications and Technology (Dallas, Texas, April 13-17, 1975)

EDRS PRICE MF-$0.76 HC-$1.95 PLUS POSTAGE
DESCRIPTORS College Students; Educational Experiments; *Educational Research; *Evaluation; *Feedback; Group Instruction; Higher Education; Instructional Design; Instructional Media; *Programed Instruction; Programed Materials; Recall (Psychological); Retention; Testing; *Video Tape Recordings
IDENTIFIERS *Intermittent Information Feedback Schedule

ABSTRACT

To determine the effect of intermittent information feedback schedules on content error rate, recall and retention of videotaped programed materials viewed under group-paced conditions, 60 students were randomly assigned to four groups. Each group viewed a sequence of 240 frames, with the ratio of question frames to answer frames fixed or variable. In the experimental groups, every other or every third task frame was followed by an information frame. After the viewing, a 45-minute recall test was given. Retention tests were administered seven days later. Results showed no significant difference in error rate, recall or retention among the four groups tested. (SK)

ED105869

# INTERMITTENT FEEDBACK SCHEDULES IN VIDEOTAPED PROGRAMMED INSTRUCTION

Robert Burdman, Ph.D.
Department of Communication
Cleveland State University

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

IR001 901

Paper presented at the Research and Theory session--National Convention of the Association for Educational Communications and Technology. Dallas, Texas, April, 1975.

INTERMITTENT FEEDBACK SCHEDULES IN VIDEOTAPED PROGRAMMED INSTRUCTION*

INTRODUCTION

Principles of programmed learning have been applied to many instructional television (ITV) productions since the Gropper and Lumsdaine studies of the 1960's. Most production follow studies utilizing continuous feedback ratios, such as those carried out by Gropper, Lumsdaine et.al. (1960-1961), Carpenter and Greenhill (1963), Kress and Gropper (1964), Lublin (1965), McIntyre et. al. (1966), Estraellas and Reagan (1967), Traum (1970), and James (1970). The basic rationale behind these studies is that the effectiveness of a well produced ITV lesson would be increased if the possibility of errorless performance were increased. To this end, continuous feedback (showing the learner the correct answer contingent to a response) was utilized.

It is observed that investigation related to the utilization of diverse information feedback schedules, or knowledge of results (KR), is a significant area of ongoing research for those engaged in the study of possible reinforcers for self-instructional systems. It is also noted that while researchers and developers in the field of ITV have confined themselves to the use of continuous feedback in their studies and products, practitioners would utilize continuous or variants of intermittent information feedback. A review of the literature on KR or feedback schedules within self-instruction will indicate that neither position is warranted. Within programmed instruction, it is not clear at this time whether, or under what conditions, continuous or intermittent feedback is useful.

While some investigators (Anderson et.al. 1972) found continuous, or 100 percent, feedback more effective than 25 percent feedback (answers given on a fixed ratio to every fourth frame - FR25), Ripple (1963) reports no significant differences on criterion test scores between "feedback" and "no feedback" groups. Moore and Smith (1964), Becker (1964), Jacobs and Kulkarni (1966) also found no differences between the two conditions.

*References included in the extended Bibliography.

Holland (1965), after reviewing the KR literature, states that no difference is found when low error rate programs are used, while high error rate programs favor the feedback condition.

Krumboltz and Weisler (1965) advanced that, in a low error rate program, unanswered frames provide occasion for reinforcement. This, however, is contradicted by Lublin (1965) who found that subjects under no confirmation and variable ratio 50 percent (VR50) feedback did better than subjects under FR50 and FR100.

Moss and Neidt (1969) approached the problem within the frame of information theory. They concluded that feedback is effective within high uncertainty conditions.

The literature also yields examples of no feedback schedule effect. Glaser and Taber (1961) and Sharf (1962) using symbolic logic programs, found, in separate experiments no differences between FR100, FR50, VR50, and VR25. Krumboltz and Weisman (1962), Driskill (1964), and Rosenstock et.al. (1965) found comparable results.

More recently, Black and Pysh (1967) and Pysh et.al.(1969) came up with no significant differences among post test, gain, or error scores, for groups under five feedback conditions, utilizing high error rate programs. These findings contradict Holland's position.

The studies reviewed, as well as the present study, were not directly aimed at arguing whether or not answers are reinforcers. The question addressed is: Does externally manipulated feedback, in any way, affect performance on the criterion measure during and after program instruction?

Purpose:

The purpose of the study was to determine the effect of intermittent information feedback schedules on content error rate, recall and retention of videotaped programmed materials viewed under group-paced conditions.

Operational Definitions

Linear programmed learning: a programming technique presenting one predominant path for the learner to follow. It employs overt responses of the constructed type plus finely divided incremental steps to foster errorless performance. The only programming technique which lends itself easily to television.

Frame: Each of the small steps into which the subject matter is divided. In a linear program the learner must respond to each frame in succession.

Constructed Task Frame: A frame in which the learner has to fill in a blank to register an answer.

Information Frame: A frame giving information, instructions, or answers to the learner.

(DV) Error Rate: An average, expressed in percentage points, derived from the ratio of wrong answers over the total number of correct answers possible.

(IV) Programmed Unit: Each of the discrete programmed sections selected as content for the videotapes used as stimuli in this study.

(IV) Intermittent Information Feedback Schedules: A ratio, either fixed or variable, of question-frames to answer-frames shown to the subject. The schedules used in this study were:

Fixed ratio 50 percent (FR50) and Fixed ratio 30 percent (FR30). Experimental conditions under which every other (FR50) or every third (FR30) task frame is followed by an information frame showing

9. The interaction between intermittent information feedback schedules and programmed units, when measured on retention, is significant.

METHODOLOGY:

Subject:

From a pool of 185 undergraduate students enrolled in a general requirement Health Education course, volunteers were asked by the instructor to participate in this study. Sixty students, with no previous formal instruction in psychology, were admitted as subjects. No additional credit was offered for taking part in the project.

Subjects were randomly assigned to four groups. From the 60 original subjects only 32 completed the experiment.

Design:

A counterbalanced, 4 x 4 fixed factorial design was selected for the study. This type of design is most appropriate when pre-tests are undesirable and when limitations such as sampling through availability exists (Campbell and Stanley, 1970).

Figure 1 shows how in this type of design groups are randomized over the experimental conditions.

| Programmed Units | Intermittent Information Feedback Schedule | | | |
|---|---|---|---|---|
| | FR50 | VR50 | FR30 | VR30 |
| I | A | B | C | D |
| II | B | A | D | C |
| III | C | D | A | B |
| IV | D | C | B | A |

Figure 1 Counterbalanced Design. Latin Square Assignment of Groups to Treatments.

Stimuli

. . . . The programmed materials used in the present study include the following sections from B.F. Skinner and J.G. Holland The Analysis of Behavior (New York: McGraw-Hill, 1961):

I: Unit 6 - Response Mechanisms

II: Unit 7 - Introduction to Operant Conditioning

III: Unit 8 - The Standard Experimental Situation

IV: Unit 9 - Positive and Negative Reinforcement

The sequence had a total of 240 frames.

The selection of the book was based on the fact that it was programmed for and revised with a population similar to the one from which the sample was drawn. Portions of the book, like the units selected, had been used in similar research (Moore and Smith, 1964; Lublin, 1965; Anderson, 1968).

The ratio schedules were selected based on the review of the literature (C.F. Blank and Pysh, 1967; Lublin, 1965; Krumboltz and Weisman, 1962). Larger variable ratios may have blocked information at such a level that the feedback function of the schedule may have been defeated.

Table I indicates which of the task frames were to be followed by information frames showing the correct response.

---

INSERT TABLE I ABOUT HERE

---

The task and information frames were transposed onto 35mm color slides, observing the adequate aspect ratio, slide critical area, size of printed characters and amount of printed material per slide to insure adequate readability of the materials when viewed on a television screen. Four sets containing four programmed units each were thus constructed.

TABLE I

FEEDBACK SCHEDULES PER FRAME

| FR50 | VR50 | FR30 | VR30 |
|---|---|---|---|
| | 1 | | |
| 2 | 2 | | |
| | | 3 | |
| 4 | 4 | | 4 |
| | 5 | | |
| 6 | | 6 | 6 |
| 8 | | | |
| | 9 | 9 | 9 |
| 10 | | | |
| | 11 | | |
| 12 | | 12 | 12 |
| | 13 | | |
| 14 | 14 | | |
| | | 15 | 15 |
| 16 | | | 16 |
| | 17 | | |
| 18 | 18 | 18 | |
| | 19 | | 19 |
| 20 | | | 20 |
| | | 21 | 21 |
| 22 | 22 | | |
| 24 | 24 | 24 | |
| | 25 | | |
| 26 | | | |
| | | 27 | |
| 28 | | | |
| | | | 29 |
| 30 | 30 | 30 | |

*Feedback frames randomly selected.

In order to determine the average time required for a subject to respond to each of the task frames in each of the units, a sub-sample of ten volunteers was drawn from the same population. Subjects viewed the sequences one at a time.

The slides were shown to the subjects so that an image equivalent to that appearing on a 21 inch television receiver was projected on the screen. The subjects were seated 12 feet away from the screen; the conditions thus obtained were equivalent to those to be encountered by the subject seated at the most distant position from the set during the treatment phase.

Subjects within this test phase worked under no time constraints.

---

INSERT TABLE II ABOUT HERE

---

Table II shows the average response time computed for each frame and total for each unit. A record of the times per task frame per unit per subject is shown in Appendix A. Following the selected design the slide sets were regrouped for videotaping as shown in Figure 3.

| Unit Number | Treatment Group | | | |
|---|---|---|---|---|
| | A | B | C | D |
| I | FR50 | VR50 | FR30 | VR30 |
| II | VR50 | FR50 | VR30 | FR30 |
| III | FR30 | VR30 | FR50 | VR50 |
| IV | VR30 | FR30 | VR50 | FR50 |

---

Figure 3:
Sets of slides rearranged into Final Sequence for Stimulus Presentation (all nomenclature indicate treatment to be exposed to.)

TABLE II

AVERAGE TIME PER TASK FRAME PER UNIT
AND TOTAL TIME PER UNIT
(in seconds)

| Task Frame Number | Unit Number I | II | III | IV |
|---|---|---|---|---|
| 1 | 17 | 14 | 18 | 22 |
| 2 | 19 | 15 | 20 | 22 |
| 3 | 19 | 11 | 27 | 21 |
| 4 | 19 | 13 | 19 | 18 |
| 5 | 19 | 19 | 21 | 23 |
| 6 | 17 | 14 | 17 | 20 |
| 7 | 20 | 20 | 19 | 24 |
| 8 | 16 | 16 | 30 | 18 |
| 9 | 14 | 15 | 24 | 17 |
| 10 | 15 | 15 | 18 | 17 |
| 11 | 32 | 16 | 27 | 19 |
| 12 | 24 | 18 | 17 | 20 |
| 13 | 23 | 18 | 22 | 18 |
| 14 | 22 | 18 | 17 | 18 |
| 15 | 19 | 18 | 17 | 19 |
| 16 | 15 | 15 | 23 | 16 |
| 17 | 25 | 24 | 23 | 16 |
| 18 | 23 | 13 | 24 | 24 |
| 19 | 26 | 15 | 19 | 19 |
| 20 | 27 | 16 | 30 | 20 |
| 21 | 23 | 25 | 27 | 20 |
| 22 | 26 | 18 | 20 | 22 |
| 23 | 22 | 20 | 20 | 25 |
| 24 | 33 | 26 | 20 | 23 |
| 25 | 20 | 14 | 16 | 15 |
| 26 | 29 | 19 | 17 | 16 |
| 27 | 33 | 21 | 17 | 16 |
| 28 | 19 | 14 | 21 | 19 |
| 29 | 28 | 23 | 26 | 21 |
| 30 | | 21 | 23 | |
| 31 | | | 23 | |
| Task Frame Total | 9'51" | 8'44" | 11'18" | 9'28" |

NOTE: To determine total running time per unit per treatment add 1'40" for FR50 and VR50, and 1'10" for FR30 and VR30.

Four videotapes were produced, one for each group. The sequences followed the feedback pattern as set above.

Only "takes" were used in the production of the 3/4 inch videocassette. Approximately one second before each take, a tone was sounded to alert the subjects to the change in frames. This was the only sound in the tapes.

Response Records

All responses were registered in writing on booklets especially printed for this purpose. Each answer booklet page represented an answer frame. The pages were numbered to facilitate identification and correspondence to the appropriate task frame within each unit.

The post-test booklets showed the units' content with all formal prompts removed. The delayed post-test booklets were similar to the immediate post-tests ones.

Information exhibits as required by the units were available, while viewing the videotapes; however, none were provided during the testing stage of the project.

Stimulus Presentation

Subjects received treatment under conditions that attempted to insure optimum viewing. Two stations were set, 21 inch black and white monitors were used. The distance from the monitors to the closest seat was about six feet and 12 feet to the most distant seat. Seven subjects were accomodated in one station, eight in the other.

Once the subjects were seated, the investigator handed out the answer booklets and exhibits corresponding to unit I and read the following instructions:

> You have volunteered to participate in a study which will aid in determining the validity of programmed learning in instructional television. You will be viewing four short programs on basic concepts of operant and reflex conditioning. Your performance here will, in no way, adversely affect your grades in HE 150/250. The following will be required of you: Through the television monitors here, you will be shown a statement with a word or words missing, like this one here (SHOW SAMPLE FRAME). It will be your task to "fill in the blanks" by writing the appropriate words in your answer booklets with the pencils provided. Each statement appearing on the screen will be numbered; you should use the same page number in your answer booklet to write your answer down. You will notice that the following simple rules have been adopted:
>
> If there is one word missing, there will be one blank; if there are two or more words missing, there will be two or more blanks; if a broken line appears, you can use as many words as you need to fill the blank.
>
> When a double T in parenthesis (TT) appears within the blank space, use the technical terms shown on the exhibit. For example: the technical term for reward is reinforcement, and that is what you should write down, reinforcement and not reward.
>
> A tone will sound approximately one second before the statement on the screen changes. When the tone sounds, please stop writing and turn the answer page. Be ready for the next statement. Once the statement appears on the screen, read it and write down what you think is the appropriate answer on the corresponding page in your answer booklet (the one displaying the same number as the statement on the screen). Once you have done so, turn the page and be ready for the next statement. Some statements will be followed by the same statement with the blanks correctly completes, like this example (SHOW SAMPLE FRAME). You may check back on your answers, but you may not change them. These information statements will be shown for seven seconds; the tone will sound to indicate that a new statement is coming up and you should get ready to answer it.
>
> Adequate time has been provided for you to read the statements and write down your answers if you know them. If you cannot think of an adequate answer, please cross out the page and go to the next one. Please write your name on the front cover of the booklet and circle the letter of the group

to which you belong. At the end of each program I will collect the booklets and will give you further instructions. Are there any questions?

If there were no questions, the tape was started and the units were shown one at a time. At the end of each unit the subjects returned their materials to the investigator. The recall test booklets were distributed after the investigator read the following instructions to the subjects:

> You will now receive a booklet which is a replicate of the program you just completed. Please go through it as rapidly as you can work, filling in as many blanks as you can. If you do not remember an answer, cross out the page and go on to the next statement. Do not look back on your work. Fill in as many blanks as possible and work as fast as you can. Are there any questions?

If there were no questions, the investigator asked the subjects to begin working. The maximum time allowed for the retention test was the time allotted for the viewing of the corresponding unit. The same procedure was followed with all segments and with all groups.

The retention test total time was set at 45 minutes, which is the approximate total time required for the continued viewing of a sequence. This test was administered by the subjects' regular instructor in the subjects' regular classroom seven days after the treatment for each of the groups.

The booklets showed the group and name of the subject on the front page. The four booklets were handed to the subjects as a package after the instructor read the following instructions:

> These are the post-tests of the programmed learning study you are participating in. You are to go through these booklets from number one to number four, filling in as many

blanks as possible as fast as you can. If you do not remember an answer, cross the page with a line and go on to the next statement.

Do not look back on your work. This is extremely important. You have a total of 45 minutes to complete all four booklets. I will be keeping time and I will advise you when the time for each booklet is up. I will also let you know when to stop working and turn your booklets in. If you finish with one booklet before my signal, go on to the next one. If you finish with all booklets before my final signal, please bring them to me. If there are no questions, you can start working.

The times set for each booklet were 11, 10, 13, and 11 minutes respectively. The instructor reported that all subjects finished working well within the time allotted. The instructor was asked to carefully monitor the subjects to avoid searching back for confirmation of answers in the booklets.

Analysis of the Data

The raw score from each booklet was transformed into error rates. The error rate per program per treatment per subject is presented in Appendix B, together with a conversion table from error rates to incorrect number of frames.

A fixed model two-way analysis of variance (Glass and Stanley, 1970) was utilized to calculate the F ratios needed to test the experimental hypotheses. Significance was established at the 0.05 confidence level. The Scheffé method for multiple comparisons (Glass and Stanley, 1970) was to be utilized to establish significant differences between specific treatments.

## PRESENTATION AND ANALYSIS OF RESULTS

### Unit Error Rate

The data resulting from the viewing of the videotapes are presented here. The summary for the analysis of variance is presented in Table III. The F ratios tested hypotheses numbers one through three.

---

INSERT TABLE III ABOUT HERE

---

The data gathered during the viewing of the program does not support the hypotheses advanced. All of the F ratios associated with unit error rate failed to reach significance.

Error rates registered while viewing the videotapes were not affected by the amount of feedback afforded to the subjects. The level of difficulty of each unit did not affect error rates significantly. The absence of interaction indicates that the schedules and units acted on error rate independently from each other.

The best predictors for the different levels of the independent variables at this testing point are the representative means and standard deviations as shown in Table IV.

---

INSERT TABLE IV ABOUT HERE

---

As can be observed, the variable ratios produced lower means and standard deviations showing a decrease in error rate associated with the decrement and randomization of information by schedules.

### Recall

The data resulting from the test taken by the subjects immediately after viewing the videotapes are presented here. The summary for the

TABLE III

UNIT ERROR RATE: SUMMARY TABLE FOR THE TWO-DIMENSIONAL ANALYSIS OF VARIANCE OF THE INTERMITTENT FEEDBACK SCHEDULES AND PROGRAMMED UNIT EFFECTS ON UNIT ERROR RATE; AND INTERACTION ANALYSIS

| Source of Variation | SS | df | MS | F |
|---|---|---|---|---|
| Intermittent Feedback Schedules | 622.25 | 3 | 207.42 | 0.50 |
| Programmed Units | 2,054.25 | 3 | 684.75 | 1.65 |
| Intermittent Feedback Schedules X Programmed Units | 5,087.00 | 9 | 565.22 | 1.36 |
| Within Cells | 6,644.00 | 16 | 415.25 | |
| Total | 14,407.50 | 31 | | |

| Mean Squares for the Obtained F Ratios | | | Obtained F Ratio | Tabulated F for p=0.05 |
|---|---|---|---|---|
| $\frac{\text{MS Intermittent Feedback Schedules}}{\text{MS Within Cells}}$ | $= \frac{207.42}{415.25}$ | = | 0.50 | = 3.24(df 3;16) |
| $\frac{\text{MS Programmed Units}}{\text{MS Within Cells}}$ | $= \frac{684.75}{415.25}$ | = | 1.65 | 3.24(df 3;16) |
| $\frac{\text{MS Intermittent Feedback Schedules X Programmed Units}}{\text{MS Within Cells}}$ | $= \frac{565.22}{415.25}$ | = | 1.36 | 2.54(df 9;16) |

TABLE IV

UNIT ERROR RATE: OVERALL MEANS AND STANDARD DEVIATIONS CALCULATED FOR EACH FEEDBACK SCHEDULE CONDITION AND EACH PROGRAMMED UNIT

| Variable | $\bar{X}$ | SD |
|---|---|---|
| Fixed Ratio 50 | 39.13 | 24.95 |
| Variable Ratio 50 | 27.50 | 19.35 |
| Fixed Ratio 30 | 37.13 | 23.47 |
| Variable Ratio 30 | 33.75 | 20.24 |
| Unit I | 24.50 | 10.97 |
| Unit II | 28.63 | 22.44 |
| Unit III | 43.63 | 24.29 |
| Unit IV | 40.75 | 23.20 |

Cell n = 8; N = 32.

analysis of variance is presented in Table V. The F ratios tested for hypotheses numbers four through six.

---

INSERT TABLE V ABOUT HERE

---

As shown in the above table none of the F ratios reached significance; therefore, it can be stated that there are no significant differences between recall scores when grouped within the different feedback conditions. The recall error rates were not significantly affected by the amount of feedback obtained during the different feedback conditions. The differences between programmed units did not affect significantly the recall scores; the independent variables did not interact with the criterion measure.

The best predictors for the different levels of the independent variables at this test point are the representative means and standard deviations presented in Table VI.

---

INSERT TABLE VI ABOUT HERE

---

As can be noted, the pattern of depressed error rates associated with decreased information is not followed. The variable ratios, however, show the lowest dispersion measure. It can be observed that the recall error rates are lower than the error rates obtained while viewing the programmed sequences.

Retention

The results of the retention test, administered seven days after the recall test are presented here. Hypotheses numbers seven through nine are tested by the F ratios presented in Table VII.

TABLE V

RECALL: SUMMARY TABLE FOR THE TWO-DIMENSIONAL ANALYSIS OF VARIANCE OF THE INTERMITTENT FEEDBACK SCHEDULES AND PROGRAMMED UNIT EFFECTS ON UNIT ERROR RATE; AND INTERACTION ANALYSIS

| Source of Variation | SS | df | MS | F |
|---|---|---|---|---|
| Intermittent Feedback Schedules | 565.62 | 3 | 188.54 | 0.60 |
| Programmed Units | 1,346.12 | 3 | 448.71 | 1.43 |
| Intermittent Feedback Schedules X Programmed Units | 3,695.12 | 9 | 410.57 | 1.31 |
| Within Cells | 5,018.00 | 16 | 313.63 | |
| Total | 10,624.86 | 31 | | |

| Mean Squares for the Obtained F Ratios | | | Obtained F Ratio | Tabulated F for p=0.05 |
|---|---|---|---|---|
| $\frac{\text{MS Intermittent Feedback Schedules}}{\text{MS Within Cells}}$ | $= \frac{565.62}{5,018.00} =$ | | 0.60 | 3.24(df 3;16) |
| $\frac{\text{MS Programmed Units}}{\text{MS Within Cells}}$ | $= \frac{1,346.12}{5,018.00} =$ | | 1.43 | 3.24(df 3;16) |
| $\frac{\text{MS Intermittent Feedback Schedules X Programmed Units}}{\text{MS Within Cells}}$ | $= \frac{3,695.12}{5,018.00} =$ | | 1.31 | 2.54(df 9;16) |

TABLE VI

RECALL: OVERALL MEANS AND STANDARD DEVIATIONS CALCULATED FOR EACH FEEDBACK SCHEDULE CONDITION AND EACH PROGRAMMED UNIT

| Variable | $\bar{X}$ | SD |
|---|---|---|
| Fixed Ratio 50 | 26.13 | 20.86 |
| Variable Ratio 50 | 15.75 | 15.58 |
| Fixed Ratio 30 | 23.50 | 20.69 |
| Variable Ratio 30 | 25.88 | 16.84 |
| Unit I | 13.25 | 13.24 |
| Unit II | 21.25 | 19.13 |
| Unit III | 30.88 | 19.84 |
| Unit IV | 25.88 | 19.75 |

Cell n = 8; N = 32.

INSERT TABLE VII ABOUT HERE

None of the calculated F ratios reached significance. Intermittent feedback schedules and programmed units did not affect significantly the error rates generated by the retention test. The best predictors for the independent variables are the representative means and standard deviations shown in Table VIII.

INSERT TABLE VIII ABOUT HERE

As can be observed, the data presented in the above table do not follow the pattern established for the recall test in Table VI. The variable ratio with the least information shows the highest error rate. The VR50 treatment level appears to be the most stable; on the overall, schedule effects were not strong enough to stabilize their influence on the dependent variable. The unit effects seem more stable. It should also be noted that error rates at this test point are the lowest in the study.

COMMENTS AND CONCLUSIONS

The two independent variables, intermittent information feedback schedules are programmed units, had no significant effects on the dependent variable under study. The effects were tested at three points in time: while viewing a group-paced, videotaped presentation of four programmed units under different feedback conditions; immediately after viewing each programmed unit; and seven days after treatment.

Nine hypotheses were tested concerning the predicted main and interaction effects of the variables under study. The first three dealth with

TABLE VII

RETENTION: SUMMARY TABLE FOR THE TWO-DIMENSIONAL ANALYSIS OF VARIANCE OF THE INTERMITTENT FEEDBACK SCHEDULES AND PROGRAMMED UNIT EFFECTS ON UNIT ERROR RATE; AND INTERACTION ANALYSIS

| Source of Variation | SS | df | MS | F |
|---|---|---|---|---|
| Intermittent Feedback Schedules | 1,000.59 | 3 | 333.53 | 1.33 |
| Programmed Units | 2,237.59 | 3 | 745.86 | 2.97 |
| Intermittent Feedback Schedules X Programmed Units | 3,551.53 | 9 | 394.61 | 1.57 |
| Within Cells | 4,019.50 | 16 | 251.22 | |
| Total | 10,809.21 | 31 | | |

| Mean Squares for the Obtained F Ratios | | | Obtained F Ratio | Tabulated F for p=0.05 |
|---|---|---|---|---|
| $\frac{\text{MS Intermittent Feedback Schedules}}{\text{MS Within Cells}}$ | $= \frac{1,000.59}{4,019.50}$ | $=$ | 1.33 | 3.24(df 3;16) |
| $\frac{\text{MS Programmed Units}}{\text{MS Within Cells}}$ | $= \frac{2,237.50}{4,019.50}$ | $=$ | 2.97 | 3.24(df 3;16) |
| $\frac{\text{MS Intermittent Feedback Schedules X Programmed Units}}{\text{MS Within Cells}}$ | $= \frac{3,551.53}{4,019.50}$ | $=$ | 1.57 | 2.54(df 9;16) |

TABLE VIII

RETENTION: OVERALL MEANS AND STANDARD DEVIATIONS CALCULATED FOR EACH FEEDBACK SCHEDULE CONDITION AND EACH PROGRAMMED UNIT

| Variable | $\bar{X}$ | SD |
|---|---|---|
| Fixed Ratio 50 | 24.50 | 22.78 |
| Variable Ratio 50 | 12.13 | 8.30 |
| Fixed Ratio 30 | 18.38 | 19.81 |
| Variable Ratio 30 | 26.38 | 20.52 |
| Unit I | 6.88 | 6.49 |
| Unit II | 19.88 | 19.44 |
| Unit III | 26.63 | 21.33 |
| Unit IV | 28.00 | 21.62 |

Cell n = 8; N = 32.

treatment effects on the responses registered while viewing the videotapes. The hypotheses are:

1. The difference between intermittent information feedback schedules error rates are significant.
2. The differences between programmed units are significant.
3. The interaction between intermittent information feedback schedules and programmed units is significant.

The data gathered from the unit answer booklets did not sustain the above hypotheses. The fixed ratios generated the highest error rates at this point; the differences, as stated, were not significant.

It can be speculated that when the subjects had the information presented to them in a regular pattern, they waited for the program to supply the answer without troubling themselves to think through the frame. The variable ratios may have created a sense of competition between subjects and television set; apparently they were stimulated to outguess the randomly appearing confirmation frames. The above is in line with Skinner's thoughts on the effects of variable ratios on response behavior; it also confirms Lublin's observations in her 1965 study mentioned earlier.

The apparent contradiction of the high error rate generated by the VR30 schedule can be attributed to the amount of information carried by the schedule. As observed, the VR30 schedule produced the highest error rate in the retention test, VR50 the lowest.

The levels of difficulty of the programmed units were not significantly different. The interaction component of the analysis also failed to reach significance, indicating that the variables were indeed acting independently from each other.

The data from the recall booklets failed to support the following hypotheses:

4. The differences between the recall error rates produced by the intermittent information feedback schedules are significant.
5. The differences between the recall error rated produced by the programmed units are significant.
6. The interaction between information feedback schedules and programmed units, when measured on recall, is significant.

None of the comparisons reached significance; however, there are some factors which are worth noting:

The FR30 schedule produced a lower error rate at this point than the VR30 schedule. Although both schedules carried the same amount of information, FR30 presented it in a systematic, predictable, fashion. This may have been a contributing factor on the effect of this schedule on the dependent variable. There is an apparent effect of amount of information and randomization of this information on error rate.

The programmed unit effect remained relatively unchanged at this point. Interaction effects were also not significant.

The recall error rates were lower than the rates recorded while viewing the tapes. This effect may be attributed to the searching for confirmation of responses in other frames, and to repeated practice. Although all formal prompts were removed from the answer booklets, subjects may have found intrinsic confirmation of answers going over the task frames more than one time.

Hypotheses seven through nine covered the predicted effects of the independent variables on the retention test:

7. The differences between the retention error rates produced by the intermittent information feedback schedules are significant.

8. The differences between the retention error rates produced by the programmed units are significant.

9. The interaction between the intermittent information feedback schedules and programmed units, when measured on retention, is significant.

The analysis of the data did not warrant the retention of the above hypotheses. The feedback schedules effect was not significant; VR50 and FR30 maintained the same relative position as in the previous test.

From the schedules utilized in this study, VR50 generated the lowest and most homogeneous scores. The amount of information conveyed, and the random pattern through which the information was offered, may have combined to generate the depressed error rates; the differences obtained were not strong enough to make a statistical statement.

Because of the sample used, student expectations on the television program may have been a factor. None of the subjects complained from boredom, or of the length of the different presentations. It is difficult to speculate on the effects of such a variable within the realm of the present study.

The lack of interaction between information feedback schedules and the programmed units suggest that the feedback mode and the effects of the content of the programmed materials could be studied independently from each other. The lack of significant feedback effects on error rates could not be attributed to program content in this case.

The limited scope of the present study begs for caution in formulating implications or suggestions for further study. Keeping these in mind, the following are advanced:

The present findings are in agreement with findings in the field of self-paced, non-mediated programmed learning. Television, in the basic format used in this study, did not seem to interfere with the variables under study.

The addition of different variables to the basic ones manipulated in this study seem to be in order. This will enable the investigators and practitioners in the field of instructional television to take full advantage of a programmed learning format adapted to the television medium using experimentally-tested variables.

Taking the above into consideration, the following are suggested. The order in which these variables are presented does not denote ranking:

The use of extrinsic feedback plus tangible rewards.

The length of the program step.

The length of the program itself.

Contrasting "high" and "low" error rate programs.

The effects of different rates of information presentation on the effects of feedback.

The reassessment of the influence of schedules with optimum amounts of information and random patterns of confirmation (such as VR50 and FR30 as used in this study) or error rate.

The present results suggest that the program content may operate as a feedback mode in itself. With confirmation from further research, emphasis should be placed on the inclusion of clues guiding the learner to critical parts of the program.

The use of extrinsic intermittent information feedback schedules does not seem to depress error rate. Curtailment in the use of such schedules

in favor of expanded content or intrinsic feedback should be considered.

Discounting the differences between self-paced and group-paced, mediated programmed learning, the present study supports the theory that externally manipulated feedback will not influence error rate. Feedback effects on the dependent variable were weaker than those observed for the programmed units. This again, lends support to the thesis that error rates are influenced primarily by the program content and structure than by the amount of feedback received through schedules. In conclusion, it can be stated, together with Pysh et.al. that:

> In summary, it would appear that the pivotal assumption, that programmed instruction's effectiveness derives from explicit provision of KR in the form of a confirmation frame within which the learner compares his ante-dating response, requires reappraisal. (p. 62)

# APPENDIX A

Response Mechanisms I
Time per frame on 10 subjects

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20 | 12 | 18 | 13 | 14 | 22 | 21 | 18 | 16 | 13 |
| 2 | 24 | 16 | 18 | 17 | 18 | 20 | 20 | 19 | 17 | 16 |
| 3 | 22 | 16 | 17 | 16 | 17 | 22 | 23 | 17 | 18 | 19 |
| 4 | 24 | 18 | 18 | 17 | 16 | 23 | 22 | 19 | 17 | 19 |
| 5 | 20 | 20 | 19 | 17 | 18 | 21 | 24 | 19 | 16 | 18 |
| 6 | 18 | 12 | 16 | 17 | 18 | 19 | 18 | 18 | 17 | 18 |
| 7 | 29 | 15 | 17 | 18 | 19 | 18 | 19 | 24 | 21 | 23 |
| 8 | 15 | 15 | 16 | 17 | 16 | 17 | 15 | 14 | 16 | 18 |
| 9 | 15 | 9 | 12 | 13 | 16 | 14 | 15 | 17 | 14 | 17 |
| 10 | 21 | 12 | 14 | 15 | 13 | 13 | 15 | 16 | 13 | 19 |
| 11 | 30 | 32 | 30 | 35 | 32 | 31 | 30 | 36 | 30 | 37 |
| 12 | 26 | 22 | 25 | 23 | 25 | 26 | 22 | 21 | 20 | 27 |
| 13 | 29 | 18 | 19 | 25 | 23 | 24 | 28 | 19 | 16 | 28 |
| 14 | 28 | 18 | 18 | 16 | 26 | 27 | 24 | 21 | 18 | 20 |
| 15 | 20 | 16 | 18 | 16 | 21 | 19 | 18 | 20 | 18 | 19 |
| 16 | 17 | 10 | 11 | 13 | 12 | 16 | 17 | 15 | 18 | 17 |
| 17 | 30 | 24 | 21 | 26 | 21 | 23 | 24 | 28 | 27 | 29 |
| 18 | 20 | 25 | 21 | 23 | 24 | 23 | 25 | 26 | 20 | 26 |
| 19 | 30 | 23 | 27 | 24 | 23 | 26 | 23 | 28 | 29 | 29 |
| 20 | 30 | 20 | 25 | 27 | 24 | 29 | 26 | 29 | 28 | 27 |
| 21 | 29 | 13 | 23 | 24 | 25 | 23 | 18 | 25 | 22 | 26 |
| 22 | 34 | 19 | 19 | 28 | 24 | 23 | 25 | 23 | 29 | 32 |
| 23 | 20 | 24 | 21 | 20 | 25 | 22 | 23 | 22 | 25 | 32 |
| 24 | 41 | 32 | 31 | 33 | 20 | 29 | 31 | 35 | 33 | 39 |
| 25 | 31 | 25 | 33 | 31 | 28 | 29 | 28 | 30 | 28 | 32 |
| 26 | 34 | 24 | 26 | 24 | 31 | 31 | 29 | 28 | 33 | 34 |
| 27 | 32 | 32 | 33 | 35 | 33 | 32 | 31 | 34 | 34 | 36 |
| 28 | 20 | 18 | 19 | 18 | 22 | 21 | 18 | 15 | 21 | 21 |
| 29 | 31 | 19 | 30 | 27 | 24 | 27 | 20 | 31 | 33 | 31 |

Title, 7; End, 7; Answers, 7; Exhibit, 45"

Introduction to Operant Conditioning II
Time per frame on 10 subjects

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11 | 15 | 14 | 13 | 15 | 16 | 11 | 13 | 12 | 15 |
| 2 | 15 | 14 | 16 | 17 | 13 | 14 | 15 | 15 | 13 | 16 |
| 3 | 11 | 10 | 12 | 11 | 13 | 11 | 10 | 9 | 10 | 11 |
| 4 | 14 | 10 | 11 | 14 | 13 | 11 | 12 | 16 | 12 | 14 |
| 5 | 18 | 20 | 20 | 19 | 17 | 18 | 19 | 17 | 18 | 21 |
| 6 | 15 | 10 | 16 | 11 | 13 | 12 | 11 | 18 | 15 | 18 |
| 7 | 23 | 16 | 22 | 21 | 20 | 17 | 18 | 19 | 20 | 22 |
| 8 | 18 | 11 | 13 | 16 | 15 | 18 | 19 | 14 | 16 | 18 |
| 9 | 9 | 15 | 14 | 15 | 16 | 19 | 14 | 15 | 17 | 13 |
| 10 | 15 | 14 | 16 | 13 | 16 | 15 | 14 | 13 | 16 | 16 |
| 11 | 15 | 14 | 14 | 16 | 15 | 15 | 17 | 16 | 17 | 18 |
| 12 | 21 | 16 | 23 | 21 | 17 | 19 | 14 | 15 | 13 | 20 |
| 13 | 18 | 15 | 19 | 17 | 14 | 18 | 19 | 20 | 20 | 17 |
| 14 | 15 | 18 | 15 | 16 | 17 | 19 | 18 | 19 | 20 | 18 |
| 15 | 19 | 17 | 17 | 15 | 19 | 17 | 18 | 19 | 16 | 19 |
| 16 | 13 | 17 | 15 | 16 | 17 | 13 | 18 | 15 | 13 | 16 |
| 17 | 23 | 24 | 25 | 23 | 25 | 26 | 21 | 23 | 24 | 23 |
| 18 | 13 | 10 | 12 | 13 | 15 | 12 | 10 | 13 | 15 | 13 |
| 19 | 13 | 16 | 16 | 15 | 13 | 14 | 16 | 18 | 16 | 17 |
| 20 | 18 | 19 | 13 | 14 | 19 | 18 | 16 | 14 | 12 | 19 |
| 21 | 33 | 19 | 21 | 26 | 25 | 24 | 19 | 30 | 26 | 23 |
| 22 | 19 | 16 | 19 | 18 | 19 | 16 | 18 | 19 | 20 | 20 |
| 23 | 18 | 19 | 20 | 18 | 20 | 21 | 23 | 20 | 19 | 17 |
| 24 | 30 | 21 | 25 | 24 | 27 | 29 | 27 | 25 | 27 | 29 |
| 25 | 15 | 13 | 14 | 13 | 15 | 14 | 12 | 15 | 13 | 16 |
| 26 | 21 | 18 | 19 | 21 | 18 | 16 | 18 | 19 | 19 | 18 |
| 27 | 24 | 18 | 19 | 23 | 25 | 19 | 17 | 25 | 23 | 20 |
| 28 | 14 | 13 | 12 | 15 | 16 | 13 | 12 | 15 | 16 | 17 |
| 29 | 16 | 29 | 17 | 18 | 23 | 26 | 25 | 27 | 28 | 23 |
| 30 | 20 | 20 | 21 | 20 | 21 | 21 | 22 | 19 | 18 | 23 |

Title, 7; End, 7; Answers, 7

The Standard Experimental Situation - III
Time per frame on 10 subjects

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 | 20 | 16 | 21 | 16 | 17 | 21 | 18 | 19 | 19 |
| 2 | 20 | 20 | 21 | 20 | 19 | 18 | 21 | 22 | 20 | 20 |
| 3 | 30 | 19 | 30 | 28 | 26 | 27 | 28 | 29 | 25 | 31 |
| 4 | 18 | 19 | 19 | 20 | 21 | 17 | 14 | 23 | 20 | 20 |
| 5 | 21 | 19 | 19 | 22 | 21 | 18 | 19 | 23 | 24 | 20 |
| 6 | 17 | 15 | 14 | 17 | 18 | 16 | 19 | 17 | 18 | 19 |
| 7 | 26 | 18 | 16 | 19 | 16 | 19 | 17 | 19 | 20 | 19 |
| 8 | 37 | 26 | 28 | 37 | 28 | 26 | 28 | 29 | 29 | 28 |
| 9 | 22 | 24 | 25 | 24 | 22 | 23 | 23 | 23 | 25 | 24 |
| 10 | 17 | 18 | 19 | 18 | 17 | 18 | 19 | 18 | 19 | 19 |
| 11 | 32 | 22 | 25 | 22 | 26 | 27 | 31 | 28 | 26 | 29 |
| 12 | 17 | 15 | 15 | 18 | 17 | 19 | 16 | 17 | 18 | 19 |
| 13 | 26 | 24 | 21 | 23 | 19 | 19 | 18 | 21 | 23 | 24 |
| 14 | 17 | 10 | 19 | 17 | 15 | 16 | 18 | 17 | 19 | 18 |
| 15 | 20 | 17 | 18 | 16 | 17 | 17 | 18 | 17 | 19 | 19 |
| 16 | 20 | 27 | 27 | 24 | 23 | 21 | 24 | 25 | 24 | 27 |
| 17 | 25 | 16 | 25 | 19 | 21 | 20 | 23 | 24 | 25 | 27 |
| 18 | 24 | 23 | 24 | 24 | 25 | 23 | 25 | 24 | 24 | 25 |
| 19 | 25 | 19 | 20 | 18 | 24 | 24 | 18 | 19 | 18 | 20 |
| 20 | 34 | 28 | 34 | 26 | 31 | 30 | 28 | 29 | 29 | 30 |
| 21 | 28 | 25 | 26 | 24 | 25 | 26 | 27 | 28 | 26 | 29 |
| 22 | 25 | 15 | 18 | 19 | 23 | 21 | 23 | 23 | 16 | 18 |
| 23 | 23 | 16 | 18 | 19 | 19 | 21 | 23 | 22 | 21 | 19 |
| 24 | 21 | 17 | 20 | 19 | 18 | 21 | 23 | 25 | 21 | 19 |
| 25 | 18 | 15 | 16 | 15 | 15 | 16 | 17 | 18 | 16 | 18 |
| 26 | 18 | 16 | 18 | 16 | 18 | 16 | 17 | 18 | 10 | 17 |
| 27 | 15 | 18 | 17 | 16 | 15 | 18 | 16 | 17 | 18 | 19 |
| 28 | 23 | 16 | 15 | 18 | 19 | 21 | 20 | 21 | 27 | 29 |
| 29 | 30 | 26 | 23 | 24 | 31 | 31 | 26 | 24 | 28 | 21 |
| 30 | 28 | 19 | 17 | 19 | 21 | 23 | 25 | 24 | 27 | 29 |
| 31 | 23 | 20 | 21 | 22 | 21 | 24 | 23 | 25 | 24 | 25 |

Title, 7; End, 7; Answers, 7; Exhibit, 2.5"

**Positive and Negative Reinforcement - IV**
Time per frame on 10 subjects.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20 | 23 | 21 | 22 | 23 | 21 | 21 | 24 | 23 | 24 |
| 2 | 20 | 24 | 23 | 19 | 25 | 24 | 19 | 19 | 25 | 25 |
| 3 | 21 | 19 | 18 | 22 | 19 | 17 | 18 | 23 | 25 | 24 |
| 4 | 19 | 17 | 19 | 18 | 17 | 16 | 19 | 20 | 19 | 18 |
| 5 | 24 | 21 | 23 | 22 | 23 | 21 | 24 | 25 | 21 | 25 |
| 6 | 20 | 17 | 19 | 21 | 16 | 18 | 22 | 23 | 21 | 21 |
| 7 | 25 | 20 | 26 | 24 | 23 | 26 | 21 | 27 | 25 | 24 |
| 8 | 20 | 17 | 16 | 17 | 18 | 19 | 21 | 15 | 16 | 19 |
| 9 | 17 | 15 | 18 | 16 | 18 | 17 | 15 | 14 | 19 | 18 |
| 10 | 17 | 17 | 16 | 17 | 17 | 18 | 17 | 16 | 18 | 19 |
| 11 | 22 | 16 | 14 | 17 | 21 | 20 | 18 | 19 | 20 | 20 |
| 12 | 25 | 13 | 16 | 17 | 15 | 23 | 21 | 22 | 21 | 27 |
| 13 | 17 | 16 | 22 | 19 | 18 | 18 | 17 | 18 | 19 | 19 |
| 14 | 18 | 17 | 19 | 18 | 17 | 16 | 17 | 18 | 19 | 19 |
| 15 | 17 | 19 | 19 | 20 | 17 | 18 | 19 | 20 | 18 | 20 |
| 16 | 15 | 15 | 16 | 15 | 15 | 16 | 17 | 16 | 15 | 17 |
| 17 | 10 | 19 | 18 | 19 | 10 | 11 | 13 | 19 | 18 | 19 |
| 18 | 23 | 24 | 25 | 24 | 23 | 26 | 23 | 24 | 26 | 25 |
| 19 | 24 | 10 | 19 | 20 | 21 | 21 | 20 | 18 | 19 | 20 |
| 20 | 20 | 20 | 19 | 20 | 20 | 19 | 21 | 21 | 19 | 22 |
| 21 | 22 | 18 | 19 | 21 | 19 | 22 | 23 | 20 | 19 | 20 |
| 22 | 25 | 18 | 18 | 19 | 18 | 24 | 25 | 19 | 25 | 26 |
| 23 | 23 | 24 | 25 | 24 | 26 | 23 | 22 | 25 | 26 | 27 |
| 24 | 21 | 22 | 22 | 21 | 22 | 23 | 23 | 24 | 25 | 24 |
| 25 | 18 | 11 | 14 | 13 | 15 | 16 | 17 | 13 | 17 | 19 |
| 26 | 17 | 11 | 14 | 16 | 17 | 16 | 18 | 16 | 19 | 18 |
| 27 | 15 | 16 | 17 | 16 | 16 | 17 | 16 | 15 | 17 | 18 |
| 28 | 13 | 20 | 21 | 20 | 23 | 21 | 15 | 20 | 21 | 19 |
| 29 | 24 | 17 | 18 | 19 | 18 | 23 | 24 | 21 | 23 | 25 |

Title, 7; End, 7; Answers, 7

## ERROR RATE CONVERSION TABLE

### Error Rate to Incorrect Frames

| Error Rate | | | | Number of |
|---|---|---|---|---|
| Unit I | Unit II | Unit III | Unit IV | Incorrect Frames |
| 3 | 3 | 3 | 3 | 1 |
| 7 | 7 | 6 | 7 | 2 |
| 10 | 10 | 10 | 10 | 3 |
| 14 | 13 | 13 | 14 | 4 |
| 17 | 17 | 16 | 17 | 5 |
| 21 | 20 | 19 | 21 | 6 |
| 24 | 23 | 23 | 24 | 7 |
| 28 | 27 | 26 | 28 | 8 |
| 31 | 30 | 29 | 31 | 9 |
| 35 | 33 | 32 | 35 | 10 |
| 38 | 37 | 35 | 38 | 11 |
| 41 | 40 | 39 | 41 | 12 |
| 45 | 43 | 42 | 45 | 13 |
| 48 | 47 | 45 | 48 | 14 |
| 52 | 50 | 48 | 52 | 15 |
| 55 | 53 | 52 | 55 | 16 |
| 59 | 56 | 55 | 59 | 17 |
| 62 | 60 | 58 | 62 | 18 |
| 66 | 63 | 61 | 66 | 19 |
| 69 | 67 | 65 | 64 | 20 |
| 72 | 70 | 68 | 72 | 21 |
| 76 | 73 | 71 | 76 | 22 |
| 79 | 77 | 74 | 79 | 23 |
| 83 | 80 | 77 | 83 | 24 |
| 86 | 83 | 81 | 86 | 25 |
| 90 | 87 | 84 | 90 | 26 |
| 93 | 90 | 87 | 93 | 27 |
| 97 | 93 | 90 | 97 | 28 |
| 100 | 97 | 94 | 100 | 29 |
| | 100 | 97 | | 30 |
| | | 100 | | 31 |

BIBLIOGRAPHY


Adams, J. C.; Carpenter, C. R.; and Smith, Dorothy, eds. College Teaching by Television. Washington, D. C.: American Council on Education, 1948.

Allan, J. I., and Richardson, R. H. Programmed learning--a multi-media approach. Programmed Learning and Educational Technology, 1967, 4, 191-195.

Allen, M. Robert. Television, Education, and the Armed Forces. Fort Lee, N. J.: Quartermaster Training Command, 1958.

Amsel, A. Error responses and reinforcement schedules in self-instructional learning. In Teaching Machines and Programmed Learning. Edited by A. A. Lumsdaine. Washington D. C.: National Education Association of the United States, 1960.

Anderson, R. C.; Faust, G. W.; and Roderick, M. C. Overprompting in programmed instruction. Journal of Educational Psychology, 1968, 59, 88-93.

Anderson, R. C.; Faust, W. G.; Roderick, Marianne; Cunningham, D. J.; and Andre, Thomas. Current Research on Instruction. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1969.

Anderson, R. C.; Kulhavy, R. W.; and Andre, T. Conditions under which feedback facilitates learning from programmed lessons. Journal of Educational Psychology, 1972, 63(3), 186-188

Annett, J. Feedback and Human Behavior. Baltimore: Penguin Books, 1969.

Apter, Michael T. The development of audiovisual programmed instruction. Programmed Learning and Educational Technology, 1967, 4, 302-315.

Arons, L., and May, M. A., eds. Television and Human Behavior--Tomorrow's Research in Mass Communication. New York: Appleton-Century-Crofts. 1963.

Azrin, N. H. Effects of two intermittent schedules of immediate and non-immediate punishment. Journal of Psychology. 1956. 42. 3-21.

Barcus, Delbert; Hayman, John L. Jr.; and Johnson, James T. Jr. Development of programmed learning materials for use with televised Spanish instruction. Denver-Stanford Project on the Context of Instructional Television--Report #4. Denver: Title VII Office, November 1961. (Mimeographed)

Barcus, Delbert; Hayman, John L. Jr.; and Johnson, James T. Jr. Programming instructing in Elementary Spanish. Phi Delta Kappan, March 1963, 44(6), 269-272.

Bay, Tidy E. TV as a 'Resource for Learning' in the primary and middle school. Educational TV International, December 1960, 4(4), 293-300.

Becker, J. L. The effects of withholding reinforcement in auto-instructional programs. In Trends in Programmed Instruction. Edited by G. D. Ofiesh and W. C. Meierhenry. Washington, D. C.: NEA and National Society for Programmed Instruction, 1964.

Blank, S. S., and Pysh, F. The effects of varying confirmation schedules in a high error rate program. Canadian Psychologist, 1967, 8a(1), 12-18.

Burdman, Robert. A critical analysis of programmed learning in televised instruction: An historical review. Unpublished master's thesis, University of Oregon, 1972.

Campbell, D. T., and Stanley, J. C. Experimental and Quasi-Experimental Designs for Research. Chicago: Rand, McNally & Co., 1970.

Campeau, P. L. Test anxiety and feedback in programmed instruction. Journal of Experimental Psychology, 1968, 59(3), 159-163.

Capen, Russell Damon. The effectiveness of an interaction technique using guided student's responses in the televised instruction of two units of work in a Psychology of Learning course. The University of Connecticut, 1965.

Carpenter, C. R. The application of principles of learning to instructional broadcasting. NAEB Conference Papers. Urbana, Ill.: University of Illinois, May 13, 1963, pp. 1-34.

Carpenter, C. R. Approaches to promising areas of research in the field of instructional television. New Teaching Aids for the American Classroom. Stanford, Calif.: Institute for Communications Research, 1960, pp. 73-94.

Carpenter, C. R. Boundaries of learning theories and mediators of learning. AV Communications Review, 1962, 10, 295-306.

Carpenter, C. R., and Greenhill, L. P., Senior Investigators. Comparative research on methods and media for presenting programmed courses in Mathematics and English. University Park: Pennsylvania State University, March 1963. (Mimeographed)

Chu, Godwin C., and Schramm, Wilbur. Learning from TV. What the Research Says. Stanford, Calif.: Institute for Communications Research, December 1967.

Cobb, Doran Peter. A comparison of programmed self-testing inventories in televised college health instruction. Unpublished Ph.D. dissertation, Southern Illinois University, 1966.

Costello, Lawrence F., and Gordon, G. N. Teach with Television--A Guide to Instructional Television. New York: Hastings House, 1961.

DeCecco, John P. Educational Technology: Readings in Programmed Instruction. New York: Holt-Rinehart & Winston, 1964.

Deterline, William A. An Introduction to Programmed Instruction. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

Deterline, W. A. Learning theory, teaching, and instructional technology. AV Communication Review, 1965, 13(4), 407-411.

DiMattia, Dominic T. A comparison of video tape and programmed instruction as training devices to discriminate the emotion commonly referred to as depression. Unpublished Ph.D. dissertation, University of Massachusetts, 1970.

Driskill, W. E. Partial and continuous feedback in a linear programmed instruction package. In Trends in Programmed Instruction. Edited by G. D. Ofiesh and W. C. Meierhenry. Washington. C. C.: NEA and National Society for Programmed Instruction, 1964.

Dunham, Franklin; Lowdermilk, R. R.; and Broderick, Gertrude, G. Television in Education. Washington, D. C.: U. S. Printing Office, 1958. Department of Health, Education and Welfare, Bulletin 1957, No. 21.

Dwyer, Francis M. Effects of knowledge of objectives on visualized instruction. Journal of Psychology, March 1971, 219-221.

Eisman, Edward. An examination of the use of overt responding to programmed televised instruction. Unpublished Ph.D. dissertation, United States International University, 1970.

Estes, W. K. Toward a statistical theory of learning. Psychological Review, 1950, 57, 94-107.

Estraellas, Juan. Programmed TV Instruction in a Foreign Language. Norwalk, Conn.: Continuous Progress Education, Inc., 1966.

Estraellas, Juan. Programmed TV instruction in a foreign language. Paper prepared for the Fourth Annual ITV Conference of the NAEB, April 1966.

Estraellas, Juan. The Self-Instructional Foreign Language Program at Florida Atlantic University. Boca Raton, Fla.: International Teaching Systems Corp., 1969.

Estraellas, Juan. "The self-instructional foreign language program at Florida Atlantic University. Hispania, September 1970, 53(3), 371-385.

Estraellas, J., and Regan, T. F. Programmed TV, a new teaching machine. Audio Visual Instruction, March 1967, 12(3), 270-272.

Estraellas, Juan, and Regan, Timothy. Tomorrow's language lab today. Florida FL Reporter, Winter 1965-66, 3-4.

Feldhusen, T. F., and Birt, A. A study of nine methods of presentation of programmed learning material. Journal of Educational Research, 1966, 9, 461-466.

Ferster, C. B., and Skinner, B. F. Schedules of Reinforcement. New York: Appleton-Century-Crofts, 1957.

Filep, Robert T., ed. Perspectives in Programming. New York: Macmillan & Co., 1963.

Finn, James D., and Perrin, Donald G. Teaching Machines and Programmed Learning: A Survey of the Industry. Washington, D. C.: U.S. Government Printing Office, 1962.

Frye, Charles H. Group versus individual pacing in programmed instruction. AV Communication, 1963, 11(3), 124-130.

Gage, N. L., ed. Handbook of Research on Teaching. Chicago: Rand, McNally & Co., 1963.

Games, Paul A., and Johnson, Craig F. Interpolated information and student response feedback during "breaks" in televised and related modes of instruction. Athens, Ohio: Ohio University, 1963. (Mimeographed)

Glaser, R., ed. Teaching Machines and Programmed Learning. II. Data and Directions. Washington, D. C.: Department of Audiovisual Instruction, NEA, 1965.

Glaser, R., and Taber, J. I. Investigations of the Characteristics of Programmed Learning Sequences. Programmed Learning Laboratory Coop. Research Project #691. Ch4, University of Pittsburgh, 1961.

Glass, G. V., and Stanley, J. C. Statistical Methods in Education and Psychology. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1970.

Goldbeck, R. A. The Effect of Response Mode and Learning Material Difficulty on Automated Instruction. Santa Barbara, Calif.: American Institutes for Research, September 1960.

Goldbeck, R. A., and Briggs, L. T. An Analysis of Response Mode and Feedback Factors in Automated Instruction. Santa Barbara, Calif.: American Institute for Research, November 1960.

Green, Edward J. The Learning Process and Programmed Instruction. New York: Holt, Rinehart & Winston, Inc., 1962.

Gropper, G. L. A Behavioral analysis of the role of visuals in instruction. Studies in Televised Instruction--The Role of Visuals in Verbal Learning--Report #1. Pittsburgh, Penn.: American Institute for Research, 1963.

Gropper, G. L. Controlling student responses during a visual presentation. Studies in Televised Instruction--The Role of Visuals in Verbal Learning--Report #2. Pittsburgh, Penn.: American Institutes for Research, October 1965.

Gropper, G. L. Does "Programmed Television Need Active Responding"? Audio Visual Communications Review, Spring 1967, 15(1), 5-23.

Gropper, G. L. Learning from visuals. Some behavioral considerations. Audio Visual Communications Review, 1966, 14, 37-69.

Gropper, G. L. A summary report. Studies in Televised Instruction--The Role of Visuals in Verbal Learning--Report #3. Pittsburgh, Penn.: American Institute for Research, October 1965.

Gropper, George L., and Glasgow, Zita. An Experimental Evaluation of Methods for Improving Conventional TV Lessons. Pittsburgh, Penn.: American Institutes for Research, October 1966.

Gropper, G. L., and Kress, Gerard C., Jr. Individualizing instruction through pacing procedures. AV Communications Review, 1965, 13(2), 165-182.

Gropper, G. L., and Lumsdaine, A. A. An experimental comparison of a TV lesson with a programmed TV lesson requiring student response. Studies in Televised Instruction: Report #2. Pittsburgh, Penn.: American Institutes for Research, March 1961. (Mimeographed)

Gropper, G. L., and Lumsdaine, A. A. An experimental evaluation of the contribution of self-pacing, pre-testing and active student response to the effectiveness of "programmed" TV instruction. Studies in Televised Instruction--Report #3. Pittsburgh, Penn.: American Institutes for Research, April 1961. (Mimeographed)

Gropper, G. L., and Lumsdaine, A. A. Experiments on active student responses to televised instruction. Studies in Televised Instruction Interim Report. Pittsburgh, Penn.: American Institutes for Research, April 1960. (Mimeographed)

Gropper, George L., and Lumsdaine, Arthur A. An investigation on the role of selected variables in programmed televised instruction. Studies in Televised Instruction--Report #4. Pittsburgh, Penn.: American Institute for Research, April 1961.

Gropper, G. L., and Lumsdaine, A. A. Issues in programming instructional materials for televised presentations. Studies in Televised Instruction--Report #5. Pittsburgh, Penn.: American Institutes for Research, May 1961. (Mimeographed)

Gropper, G. L., and Lumsdaine, A. A. The use of student response to improve televised instruction. Studies in Televised Instruction--Report #7. Pittsburgh, Penn.: American Institutes for Research, June 1961. (Mimeographed)

Gropper, G. L.; Lumsdaine, A. A.; and Shipman, Virginia. Improvement of televised instruction based on student responses to achievement tests. Studies in Televised Instruction--Report #1. Pittsburgh, Penn.: American Institutes for Research, March 1961.

Gropper, G. L.; Lumsdaine, A. A.; Willis, Yolanda; and Willis, Richard A. An evaluation of television procedures designed to stimulate extracurricular science activities. Studies in Televised Instruction--Report #6. Pittsburgh, Penn.: American Institute for Research, May 1961. (Mimeographed)

Gryde, S. K. The feasibility of programmed television instruction. AV Communications Review, 1966, 14(1), 73-75.

Gulo, Vaughn E., and Nigro, M. R. Classroom learning as a function of method of presenting instructional materials. Pedagogical Reports, December 1966, 19, 971-977.

Guthrie, E. R. Conditioning: a theory of learning in terms of stimulus, response, and association. 41st Yearbook. National Society for the Study of Part II; 1942, p. 23.

Hall, Keith Allen. The effects of the ability of pupils, size of step and type of cue on learning with programmed materials. Unpublished Ph.D. dissertation, Indiana University, 1963.

Hartman, Frank R. A behavioristic approach to communication: A selective review of learning theory and a derivation of postulates. AV Communications Review, 1963, 11(5), 155-190.

Hartman, Frank R. Simple and multiple channel communication: A review of research and a proposed model. AV Communications Review, 1961, 9, 235-262.

Hayman, John L., Jr. Viewer location and learning in instructional television. AV Communications Review, May-June 1963, 11(3), 27-31.

Hayman, John L., Jr., and Johnson, James T., Jr. Exact versus varied repetition in ETV. AV Communications Review, July-August 1965, 11(6), 96-103.

Hayman, T. L., Jr., and Johnson, James T., Jr. Reading and writing results in the second year of research--1961-1962. Denver-Stanford Project on the Context of Instructional Television--Report #7. Denver, Colo.: Title VII Office, May 1963.

Hayman, John L., Jr., and Johnson, James T., Jr. Third year results in the Denver-Stanford Project. Denver-Stanford Project in the Context of Instructional Television--Institute of Communications Research--Report #10. Stanford, Calif.: Stanford University, March 1964. (Mimeographed)

Hebb, D. O. The Organization of Behavior. New York: John Wiley & Sons, 1949.

Hebb, D. O. A Textbook of Psychology. 2nd edition. Philadelphia: Saunders, 1966.

Heiner, R. T. Experiment I. Comparison of external-pacing and self-pacing of programmed instruction in mathematics using different methods of presentation. In C. R. Carpenter and L. P. Greenhill, Project Directors. Comparative research on methods and media for presenting programmed courses in Mathematics and English. University Park, Penn.: Pennsylvania State University, March 1963 (mimeographed), pp. 13-25.

Hickey, Albert E.; Autor, Sanford M.; and Robinson, E. J. Programmed instruction integrated in broadcast ETV. The Research on Programmed Instruction--An Annotated Bibliography. Edited by W. Schramm. Stanford, Calif.: Institute for Communications Research, 1964.

Hoban, C. F. The usable residue of educational film research. New Teaching Aids for the American Classroom. Stanford. Calif: Institute of Communications Research, 1960, pp. 95-115.

Holland, J. Research on programming variables. In Teaching Machines and Programmed Learning II: Data and Directions. Edited by R. Glaser. Washington, D. C.: NEA, 1965.

Hough, J. B., and Revsin, B. Programmed instruction at the college level: A study of several factors influencing learning. Phi Delta Kappan, 1963, 44(6), 286-291.

Howard, Smith Mary. Using Television in the Classroom. New York: McGraw-Hill, 1961.

Howard, Smith, Mary. Uses of TV in higher education. Unpublished Ph.D. dissertation, New York University, 1954.

Hughes, J. L., ed. Programmed Learning: A Critical Evaluation. Chicago: Educational Methods, Inc., 1963.

Jacobs, P. I., and Kulkarni, S. A. Tests of some assumptions underlying programmed instruction. Psychological Reports, 1966, 18, 103-110.

James, Pamela E. A comparison of the efficiency of programmed videotape and instruction booklet in learning to operate a desk calculator. Programmed Learning and Educational Technology, 1970, 134-139.

Johnson, F. Feedback in instructional television. Journal of Communications, 1960, 10, 140-146.

Johnson, Rita B. The effects of prompting practice and feedback in programmed videotape. American Educational Research Journal, 1968, 5, 73-74.

Kahn, Frank J., ed. Documents of American Broadcasting. New York: Appleton-Century-Crofts, 1968.

Kanner, Joseph H., and Marshall, W. P. The Improvement of Television Instruction by Review Procedures. Washington, D. C.: Office of the Chief Signal Officer, May 1963.

Kimble, George A. Hilgard and Marquis' Conditioning and Learning. New York: Appleton-Century-Crofts, 1968.

Kershner, M. A. Speed of reading in an adult population under differential conditions. Journal of Applied Psychology, 1964, 48, 25-29.

Klaus, David J. Instructional Innovation and Individualization. Pittsburgh, Penn.: American Institute for Research, 1971.

Klaus, David J., and Lumsdaine. Arthur A. An Experimental Field Test of the Value of Self-Tutoring Materials in High School Physics. Pittsburgh, Penn.: American Institute for Research, 1960.

Klaus, David J., and Lumsdaine, Arthur A. Self Instructional Supplements for a Televised Physics Course. Pittsburgh, Penn.: American Institute for Research, 1959.

Komoski, P. K. A demonstration project of programmed television instruction. The Institute of Educational Technology. Teachers' College, Columbia University, New York, July 1966. (Mimeographed)

Kress, G. C., Jr., and Gropper, G. L. Accommodating individual differences during externally paced programmed instruction. Studies in Televised Instruction--Individualizing Group Instruction--Report #3. Pittsburgh, Penn.: American Institute for Research, November 1964.

Kress, G. C., Jr., and Gropper, G. L. The influence of external pacing on learning from programmed instruction. Studies in Televised Instruction Individualizing Group Instruction--Report #2. Pittsburgh, Penn.: American Institute for Research, 1964.

Kress, G. C., Jr., and Gropper, G. L. A summary report. Studies in Televised Instruction--Individualizing Group Instruction--Report #4. Pittsburgh, Penn.: American Institutes for Research, November 1964.

Krumboltz, J. D. Factors affecting difficulty level and criterion performance. Programmed Instruction, 1964, 3, 4-5.

Krumboltz, J. D., ed. Learning and the Educational Process. Chicago: Rand, McNally, 1965.

Krumboltz, J. D., and Keisler, C. A. The partial reinforcement paradigm and programmed instruction. Journal of Programmed Instruction, 1965, 3(2), 9-14.

Krumboltz, J. D., and Weisman, R. G. The effect of intermittent confirmation in programmed instruction. Journal of Educational Psychology, 1962, 53(6), 250-253.

Kumata, H. An Inventory of Instructional Television Research. Ann Arbor, Mich.: Educational Television and Radio, Winter 1958.

Landauer, T. K. Reinforcement as consolidation. Psychological Review, 1969, 76, 82-96.

Lane, Bennie Ray. An experiment with programmed instruction as a supplement to teaching college mathematics by closed-circuit TV. George Peabody College for Teachers, 1962.

Lambert, Phillip. The Teacher and the Machine. Madison, Wisc.: Dembar Educational Research Services, Inc., 1962.

Lawrence, F. Costello, and Gordon, George N. Teach with Television: A Guide to Instructional Television. New York: Hastings House, 1961.

Leith, G. O. M.; and Amaria, Reda P.; and Huf, William. Applications of programmed learning principles to the preparation of TV lessons in elementary sciences and mathematics. Programmed Learning and Educational Technology, October 1969, 6(4), 209-230.

Lublin, S. C. Reinforcement, schedules, scholastic aptitude, autonomy need, and achievement in a programmed course. Journal of Educational Psychology, 1965, 56(6), 295-302.

Lumsdaine, A. A. The development of teaching machines and programmed self-instruction. New Teaching Aids for the American Classroom. Stanford, Calif.: Institute of Communications Research, 1960, 136-173.

Lumsdaine, A. A. Student response in programmed instruction. Washington, D. C.: National Academy of Sciences, National Research Council, 1961.

Lumsdaine, A. A., and Glaser, Robert, eds. Teaching Machines and Programmed Learning: A Sourcebook. Washington, D. C.: National Education Association of the United States, 1960.

Mager, Robert F., and Clark, Cecil. Explorations in student controlled instruction. Psychological Reports, 1963, 13, 71-76.

May, M. A., and Lumsdaine, A. A. Preliminary Evaluative Studies of Science Telecasts. Pittsburgh, Penn.: American Institute for Research, 1958.

McDonald, Thomas F. The effect of auditory, supraliminal and written reinforcement of words presented by instructional television on the vocabulary development of seventh and eighth grade pupils. Unpublished Ph.D. dissertation, Arizona State University, 1969.

McIntyre, Charles J.; Tiemann, Philip W.; and Paden, Donald W. An application of the principles of programmed instruction to a televised course in college economics. Urbana, Ill.: University of Illinois, April 1966.

McLennan, Donald W. Development of a linear, constructed response program for teaching basic television picture to college students. Unpublished Ph.D. dissertation, University of Missouri, 1969.

Meierhenry, W. C., ed. Learning theory and A. V. utilization. Audiovisual Communication Review, 1961, 9(5), 1-88.

Moore, D. L. Group teaching by programmed instruction. Programmed Learning and Educational Technology, 1967, 5, 37-46.

Moore, J., and Smith, W. L. Role of knowledge of results in programmed instruction. Psychological Reports. 1964, 14, 407-423.

Moore, Nicholson F. A comparative study of teaching strategies involving CCTV and programmed instruction. Unpublished Ph.D. dissertation, Ohio State University, 1969.

Moss, R. E., and Neidt, C. O. Applicability of information theory to learning. Psychological Reports, 1969, 24, 471-478.

Mowrer, D. Hobart. Learning Theory and Behavior. New York: Wiley & Sons, Inc., 1960.

Nicholas, Donald Lee. The effect of pacing rate on the efficiency of learning from programmed instructional materials. Unpublished Ph.D. dissertation, Indiana University, 1966.

Nicholson, Moore Frederick. A comparative study of teaching strategies involving closed-circuit television and programmed instruction. Unpublished Ph.D. dissertation, Ohio State University, 1969.

Nurberber, Robert G. The effect of active response in ETV instruction. NSPI Journal, March 1969, 8, 18-20.

Oliphant, R. Instructional television and programmed learning--Some problems of application and policy. Journal of Higher Education, 1964, 35, 488-492.

Powell, John Walter. Channels of Learning: The Story of Educational Television. Washington, D. C.: Public Affairs Press, 1962.

Pressman, Robert Martin. An investigation of the effect of feedback used in a programmed video tape simulation exercise designed to train teachers to reorganize the appropriate moment of reinforcement. Syracuse University, 1971.

Prutsman, Thomas D., and Laird, Dorothy S. Development of techniques to implement the principles of programmed video instruction. Washington, D. C.: United States Department of Health, Education and Welfare, Bureau of Research, May 1969. (Mimeographed)

Pysh, F.; Blank, S. S.; and Lambert, R. A. The effects of step size, response mode, and KOR upon achievement in programmed instruction. Canadian Psychologist, 1969, 10(1), 49-64.

Ripple, R. E. Comparison of the effectiveness of a programmed text with three other methods of presentation. Psychological Reports, 1963, 12, 227-237.

Roebuck, Martin (University of Glasgow). An investigation of the use of programmed learning as an adjunct to educational broadcasting. Educational Television International. 1970, 4(3), 191-192.

Rosenstock, E. J.; Moore, J. W.; and Smith, W. I. Effects of several schedules of knowledge of results on mathematics achievement. Psychological Reports, 1965, 17, 535-541.

Scharf, E. S. A study of partial reinforcement on behavior in a programmed learning situation. In R. Glaser (Project Director). Investigation of the Characteristics of Programmed Learning Sequences. Pittsburgh, Penn.: Programmed Learning Laboratory. University of Pittsburg, 1961.

Schramm, Wilbur L. The future of educational radio and TV. Educational TV International, December 1970, 4(4), 282-286.

Schramm, Wilbur L. The Research on Programmed Instruction--Annotated Bibliography. Washington, D. C.: U. S. Department of Health, Education and Welfare, U. S. Government Printing Office, 1964.

Silverman, Robert E., and Alter, Millicent. Response Mode, Pacing, and Motivational Effects in Teaching Machines. Port Washington, L.I., New York: U. S. Naval Training Device Center, 1961. (Technical Report NTDC 5-703).

Skinner, B. F. The Technology of Teaching. New York: Appleton-Century-Crofts, 1968.

Spence, K. W. Theoretical interpretations of learning. Handbook of Experimental Psychology. Edited by S. S. Stevens. New York: John Wiley & Sons, 1951, 703.

Spence, R. E. Experiment V. Comparison of televised instruction with teaching machines, and televised instruction with instructor's presentation of English grammar. In C. R. Carpenter and L. P. Greenhill (Project Directors). Comparative research on methods and media for presenting programmed courses in Mathematics and English. University Park, Penn.: Pennsylvania State University, March 1963 (mimeographed), pp. 57-63.

Swets, J. M.; Millman, S. H.; Fletcher, W. E.; and Green, D. M. Learning to identify non-verbal sounds: An application of a computer as a teaching machine. Journal of the Acoustical Society of America, 1962, 34, 928-935.

Travers, R. M. W., ed. Research and Theory Related to Audio-Visual Information Transmission. Salt Lake City: University of Utah, Bureau of Educational Research, July, 1964.

Traum, Emil Frank. An experimental comparison of CCTV and program learning used as instructional media for the performance of measurements in industrial education. Unpublished Ph.D. dissertation. University of Michigan, 1970.

Turner, Ronald Joe. Description of the development and validation of a programmed print and video-taped instructional manual. Unpublished Ph.D. dissertation, University of Missouri. 1970.

Vicory, Arthur C., and Corrigan, Robert E. Learning Math concepts through required responses and feedback: The Research on Programmed instruction. Edited by W. Schramm. Washington, D. C.: U. S. Department of HEW, U. S. Government Printing Office, 1964, 104-105

Volks, V. W. Postremity, recency, and frequency as bases for prediction in the maze situation. Journal of Experimental Psychology, 1948, 38, 495-510.

Weisgerber, E. A. ed. Instructional Process and Media Innovation. Chicago: Rand, McNally & Co., 1968.

Williams, Don. Aprenda Ingles. Florida Adult Education, April 1971, 21, 18.

Wittrock, M. C., and Twelker, P. A. Prompting and feedback in the learning, retention, and transfer of concepts. British Journal of Educational Psychology, 1964, 34(1), 10-18.